

AD-A104 221

CENTER FOR NAVAL ANALYSES ALEXANDRIA VA INST OF NAVAL--ETC F/G 5/4  
THE RAREST COMMODITY IN THE COMING RESOURCE WARS.(U)  
AUG 81 J THOMASON

UNCLASSIFIED

CNA-PP-303

NL

1 of 1  
ADA  
C4421



END  
DATE  
FILMED  
10-81  
DTIC

PROFESSIONAL PAPER 303 / August 1981

AS

AD A104221

# THE RAREST COMMODITY IN THE COMING RESOURCE WARS

James Thomason

DTIC FILE COPY



CENTER FOR NAVAL ANALYSES

This document is for public release and its distribution is unlimited.

81 9 14 061

The ideas expressed in this paper are those of the author.  
The paper does not necessarily represent the views of the  
Center for Naval Analyses.

August 1981

August 1981

CNA - PF - 202

## James Thomason



**CENTER FOR NAVAL ANALYSES**

**2000 North Beauregard Street, Alexandria, Virginia 22311**

For  
MI  
Card  
*filed in file*  
National  
Library  
of Medicine  
Division  
of  
A

403542

## THE RAREST COMMODITY IN THE COMING RESOURCE WARS

James Thomason

In the land of Oz, the tin woodman sets out to get a heart, the scarecrow a brain, the lion some nerve, and Dorothy a way home. One of the sweetest moments in the story, at least to me, occurs when the wizard finally tells them they already have what they so desperately thought only someone else could give. The point is driven home once the good witch shows Dorothy how to get back to Kansas all by herself.

The rarest commodity in recent hoopla about the "coming resource wars" may be just that sort of homespun common sense from the Wizard of Oz — what we can do for ourselves, if need be. U.S. consumers are surely better off with access to foreign goods and markets. Even a small price difference makes importing worth our while. But our economy is not doomed nor our national security in jeopardy even if we lose access to a foreign product for a while.

Oil may be different. A major, protracted loss of Persian Gulf oil would be enormously expensive. We still need better policies to reduce the chances and costs of such disruptions.

But oil is the exception. When top government officials suggest that without various exotic minerals from remote developing countries the U.S. would suffer economic calamity and be nearly unable to produce vital defense goods, they foster exaggerated fears and divert attention from far more pressing national concerns. I applaud the President's scrutiny of excess federal spending; it also ought to be vigorously extended to strategic mineral needs.

Consider cobalt, for example, our "Achilles Heel" among non-fuel minerals according to some top members of the new Administration. The gist of their argument is that the U.S. is "dangerously vulnerable" to an import cut-off of cobalt: not only do we import almost all we use and need it for the high-quality steel in jet engines and other vital defense goods, but Zaire, by far the largest cobalt producer, is politically unstable and has also been the object of some recent Cuban/Soviet "meddling." This meddling is viewed as the first step in Soviet plans to "corner the cobalt market" and then bring us to our knees in a "mineral squeeze."

Now while Soviet-backed (and other) aggression should be denounced and firmly opposed, we need to temper our fears in this case with some additional facts. First, while the U.S. uses about 8,000 tons of the metal a year, at most a quarter of it goes for defense-related goods. Second, stable alternative suppliers do exist. Canada, Australia, and New Caledonia (a French territory near Australia) now produce 10,000 tons per year and could produce more quickly. Third, the U.S. government already has enough stockpiles of cobalt (20,000 tons) for more than two years at current use rates even in an import cut-off from all sources. Fourth, America itself has cobalt resources in the ground of at least 160,000 tons, enough for at least 20 years; we stopped

producing ten years ago because it was cheaper to import. Finally, nickel is a very close substitute. The U.S. has significant reserves, but Canada provides most of our nickel — and could fill all U.S. "needs" for at least 50 years.

These resources, even those we have in the U.S. alone, are far more than sufficient to assure us all the cobalt or substitutes we could need for military purposes even in a protracted war.

Economically, this would be more costly — without any question. Exactly how much more is hard to say. But it surely would not be calamitous. In an extreme case, if cobalt prices (now \$20/lb) jumped tenfold for an entire year, the extra tab might be a couple of billion dollars, probably less. And that is a very extreme, unlikely case.

Moreover, although Zaire is not a western industrial state, what makes us think they don't want to earn all the cobalt revenues they can? A protracted cut-off would hurt them a great deal.

As for alleged Soviet plans to "corner the market" over the long term, one other rather key obstacle ought to be noted. While no one knows exactly, credible experts say there may be 24 billion tons of recoverable cobalt metal in deep-sea manganese nodules in the Pacific Ocean. Even if only one percent of this is usable, it would be enough for the U.S. for literally thousands of years! This alone makes the odds of success of any "cornering" plan just about zero.

Should cobalt interruptions occur, they may be the hardest for the U.S. to deal with — among non-fuel minerals. But our stockpile is more than adequate now. Why are we buying another 5 million pounds this year alone, and thinking of major tax breaks for domestic commercial holdings? Why is the Administration planning to spend billions of dollars over the next few years on this and other non-fuel stockpile additions and U.S. industry subsidies? Not a single plausible explanation has been offered.

Now I have focused on cobalt so far because the Administration says that's where we are in the worst shape. Yet some observers may still wonder whether I am unduly neglecting some other major strategic minerals — especially chromium, manganese and platinum. What about these others?

Chromium has three main uses: (1) in stainless steel (64%) — most of which goes for products like auto chrome that would hardly be essential in wartime; (2) in paints, leather tanning and some metal plating (16%); and (3) in coating for refractory bricks (20%). Aluminum and nickel are fine substitutes in a great many cases. Stockpiles (5.2 million tons) now equal more than four years of total imports. Our country even has minable resources. In short, U.S. resources, secondary recovery, stockpiles, substitutes, limited military needs, and chromium's many "frill" roles mean little vulnerability to conceivable import losses.

Manganese is used almost solely for steel production, but represents only a tiny share of input costs. U.S. demand is about 1.5 million tons yearly. Australia and Brazil have enormous reserves, but we have nearly 75 million tons of minable manganese. Deep seabed mining of manganese (and cobalt) is technologically feasible now; in an emergency it could start in a matter of months. Moreover, government stockpiles now contain over three years' supply at total U.S. use rates; industry has at least another year's worth.

Finally, the U.S. uses about 70 tons of platinum metals per year. Forty percent goes into auto emission-control devices — hardly critical in wartime. Given platinum's "inertness," 95 to 98 percent can now be recovered (recycled) even after five years. Stockpiles now offer a nine-month supply at total use rates, but even at present prices U.S. and Canadian reserves would allow unabated U.S. consumption for almost five years. (At higher prices, much more would be available.) In short, less than a tenth of amounts now consumed would be needed by the military in a major war — about as much as we use each year to make jewelry.

Some critics will undoubtedly try to equate my skepticism about the need for larger stockpiles and subsidies with lack of concern about Soviet aggression. Nothing could be more wrong. In my view, we as a country need a far keener awareness of the devastatingly coercive, imperialistic nature of the Soviet system. The Soviets do need to be deterred from predatory interference in the lives of peoples throughout the world — from Afghanistan to Zaire, from Poland to the Persian Gulf. The moral and geopolitical reasons for opposing such aggression are more than adequate. Saving ourselves from a putative strategic non-fuel minerals "stranglehold" is a far less compelling rationale.

Again, in terms of vulnerability, oil is the exception. The global economy does depend on avoiding a major, lengthy loss of imported oil. Our allies and the developing world are far more vulnerable than we, but we all have a critical stake. We need to focus on that.

We live far from the dream world of Oz — where good always triumphs and we have all we could want. But the moral of Dorothy's story is still sound. If we look hard at what we have, we will see we can do far more ourselves than we are often told.

CNA PROFESSIONAL PAPERS - 1978 TO PRESENT\*

- PP 211  
Mizrahi, Maurice M., "On Approximating the Circular Coverage Function," 14 pp., Feb 1978, AD A054 429
- PP 212  
Mangel, Marc, "On Singular Characteristic Initial Value Problems with Unique Solution," 20 pp., Jun 1978, AD A058 535
- PP 213  
Mangel, Marc, "Fluctuations in Systems with Multiple Steady States. Application to Lanchester Equations," 12 pp., Feb 78 (Presented at the First Annual Workshop on the Information Linkage Between Applied Mathematics and Industry, Naval PG School, Feb 23-25, 1978), AD A071 472
- PP 214  
Weinland, Robert G., "A Somewhat Different View of The Optimal Naval Posture," 37 pp., Jun 1978 (Presented at the 1976 Convention of the American Political Science Association (APSA/IUS Panel on "Changing Strategic Requirements and Military Posture"), Chicago, Ill., September 2, 1976), AD A056 228
- PP 215  
Colle, Russell C., "Comments on: Principles of Information Retrieval by Manfred Kochen," 10 pp., Mar 78 (Published as a Letter to the Editor, Journal of Documentation, Vol. 31, No. 4, pages 298-301), December 1975), AD A054 426
- PP 216  
Colle, Russell C., "Lotka's Frequency Distribution of Scientific Productivity," 18 pp., Feb 1978 (Published in the Journal of the American Society for Information Science, Vol. 28, No. 6, pp. 366-370, November 1977), AD A054 425
- PP 217  
Colle, Russell C., "Bibliometric Studies of Scientific Productivity," 17 pp., Mar 78 (Presented at the Annual Meeting of the American Society for Information Science held in San Francisco, California, October 1976), AD A054 442
- PP 218 - Classified
- PP 219  
Huntzinger, R. LaVer, "Market Analysis with Rational Expectations: Theory and Estimation," 60 pp., Apr 78, AD A054 422
- PP 220  
Maurer, Donald E., "Diagonalization by Group Matrices," 26 pp., Apr 78, AD A054 443
- PP 221  
Weinland, Robert G., "Superpower Naval Diplomacy in the October 1973 Arab-Israeli War," 76 pp., Jun 1978 (Published in Seapower in the Mediterranean: Political Utility and Military Constraints, The Washington Papers No. 61, Beverly Hills and London: Sage Publications, 1979) AD A055 564
- PP 222  
Mizrahi, Maurice M., "Correspondence Rules and Path Integrals," 30 pp., Jun 1978 (Invited paper presented at the CNRS meeting on "Mathematical Problems in Feynman's Path Integrals," Marseille, France, May 22-26, 1978) (Published in Springer Verlag Lecture Notes in Physics, 106, (1979), 234-253) AD A055 536
- PP 223  
Mangel, Marc, "Stochastic Mechanics of Molecule-Molecule Reactions," 21 pp., Jun 1978, AD A056 227
- PP 224  
Mangel, Marc, "Aggregation, Bifurcation, and Extinction in Exploited Animal Populations," 48 pp., Mar 1978, AD A058 536  
\*Portions of this work were started at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, B.C., Canada
- PP 225  
Mangel, Marc, "Oscillations, Fluctuations, and the Hopf Bifurcation," 43 pp., Jun 1978, AD A058 537  
\*Portions of this work were completed at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, Canada.
- PP 226  
Reiston, J. M. and J. W. Mohn, "Temperature and Current Dependence of Degradation in Red-Emitting GaP LEDs," 34 pp., Jun 1978 (Published in Journal of Applied Physics, 50, 3630, May 1979) AD A058 538  
\*Bell Telephone Laboratories, Inc.
- PP 227  
Mangel, Marc, "Uniform Treatment of Fluctuations at Critical Points," 50 pp., May 1978, AD A058 539
- PP 228  
Mangel, Marc, "Relaxation at Critical Points: Deterministic and Stochastic Theory," 54 pp., Jun 1978, AD A058 540
- PP 229  
Mangel, Marc, "Diffusion Theory of Reaction Rates. I: Formulation and Einstein-Smoluchowski Approximation," 50 pp., Jan 1978, AD A058 541
- PP 230  
Mangel, Marc, "Diffusion Theory of Reaction Rates. II Ornstein-Uhlenbeck Approximation," 34 pp., Feb 1978, AD A058 542
- PP 231  
Wilson, Desmond P., Jr., "Naval Projection Forces: The Case for a Responsive MAF," Aug 1978, AD A054 543
- PP 232  
Jacobson, Louis, "Can Policy Changes Be Made Acceptable to Labor?" Aug 1978 (Submitted for publication in Industrial and Labor Relations Review), AD A061 528

\*CNA Professional Papers with an AD number may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22151. Other papers are available from the Management Information Office, Center for Naval Analyses, 2000 North Beauregard Street, Alexandria, Virginia 22311. An index of Selected Publications is also available on request. The index includes a Listing of Professional Papers; with abstracts; issued from 1969 to June 1981.



- PP 233  
Jacobson, Louis, "An Alternative Explanation of the Cyclical Pattern of Quits," 23 pp., Sep 1978
- PP 234 - Revised  
Jondrow, James and Levy, Robert A., "Does Federal Expenditure Displace State and Local Expenditure: The Case of Construction Grants," 23 pp., Oct 1979, AD A061 529
- PP 235  
Mizrahi, Maurice M., "The Semiclassical Expansion of the Anharmonic-Oscillator Propagator," 41 pp., Oct 1978 (Published in Journal of Mathematical Physics 20 (1979) pp. 844-855), AD A061 538
- PP 237  
Maurer, Donald, "A Matrix Criterion for Normal Integral Bases," 10 pp., Jan 1979 (Published in the Illinois Journal of Mathematics, Vol. 22 (1978), pp. 672-681)
- PP 238  
Utgoff, Kathleen Classen, "Unemployment Insurance and The Employment Rate," 20 pp., Oct 1978 (Presented at the Conference on Economic Indicators and Performance: The Current Dilemma Facing Government and Business Leaders, presented by Indiana University Graduate School of Business), AD A061 527
- PP 239  
Trost, R. P. and Werner, J. T., "The Effects of Military Occupational Training on Civilian Earnings: An Income Selectivity Approach," 38 pp., Nov 1979k, AD A077 831
- PP 240  
Powers, Bruce, "Goals of the Center for Naval Analyses," 13 pp., Dec 1978, AD A063 759
- PP 241  
Mangel, Marc, "Fluctuations at Chemical Instabilities," 24 pp., Dec 1978 (Published in Journal of Chemical Physics, Vol. 69, No. 8, Oct 15, 1978), AD A063 787
- PP 242  
Simpson, William R., "The Analysis of Dynamically Interactive Systems (Air Combat by the Numbers)," 160 pp., Dec 1978, AD A063 760
- PP 243  
Simpson, William R., "A Probabilistic Formulation of Murphy Dynamics as Applied to the Analysis of Operational Research Problems," 18 pp., Dec 1978, AD A063 761
- PP 244  
Sherman, Allen and Horowitz, Stanley A., "Maintenance Costs of Complex Equipment," 20 pp., Dec 1978 (Published By The American Society of Naval Engineers, Naval Engineers Journal, Vol. 91, No. 6, Dec 1979) AD A071 473
- PP 245  
Simpson, William R., "The Accelerometer Methods of Obtaining Aircraft Performance from Flight Test Data (Dynamic Performance Testing)," 403 pp., Jun 1979, AD A075 226
- PP 246  
Brechtling, Frank, "Layoffs and Unemployment Insurance," 35 pp., Feb 1979 (Presented at the Nber Conference on "Low Income Labor Markets," Chicago, Jun 1978), AD A096 629
- PP 248  
Thomas, James A., Jr., "The Transport Properties of Dilute Gases in Applied Fields," 183 pp., Mar 1979, AD A096 464
- PP 249  
Glasser, Kenneth S., "A Secretary Problem with a Random Number of Choices," 23 pp., Mar 1979
- PP 250  
Mangel, Marc, "Modelling Fluctuations in Macroscopic Systems," 26 pp., Jun 1979
- PP 251  
Trost, Robert P., "The Estimation and Interpretation of Several Selectivity Models," 37 pp., Jun 1979, AD A075 941
- PP 252  
Nunn, Walter R., "Position Finding with Prior Knowledge of Covariance Parameters," 5 pp., Jun 1979 (Published in IEEE Transactions on Aerospace & Electronic Systems, Vol. AES-15, No. 3, Mar 1979)
- PP 253  
Glasser, Kenneth S., "The d-Choice Secretary Problem," 32 pp., Jun 1979, AD A075 225
- PP 254  
Mangel, Marc and Quenbeck, David B., "Integration of a Bivariate Normal Over an Offset Circle," 14 pp., Jun 1979, AD A096 471
- PP 255 - Classified, AD B051 441L
- PP 256  
Maurer, Donald E., "Using Personnel Distribution Models," 27 pp., Feb 1980, AD A082 218
- PP 257  
Thaler, R., "Discounting and Fiscal Constraints: Why Discounting Is Always Right," 10 pp., Aug 1979, AD A075 224
- PP 258  
Mangel, Marc S. and Thomas, James A., Jr., "Analytical Methods in Search Theory," 86 pp., Nov 1979, AD A077 832
- PP 259  
Glass, David V.; Hsu, Ih-Ching; Nunn, Walter R., and Perlin, David A., "A Class of Commutative Markov Matrices," 17 pp., Nov 1979, AD A077 833
- PP 260  
Mangel, Marc S. and Cope, Davis K., "Detection Rate and Sweep Width in Visual Search," 14 pp., Nov 1979, AD A077 834
- PP 261  
Villa, Carlos L.; Zvijac, David J. and Ross, John, "Frank-Condon Theory of Chemical Dynamics. VI. Angular Distributions of Reaction Products," 14 pp., Nov 1979 (Reprinted from Journal Chemical Phys. 70(12), 15 Jun 1979), AD A076 287
- PP 262  
Petersen, Charles C., "Third World Military Elites in Soviet Perspective," 50 pp., Nov 1979, AD A077 835
- PP 263  
Robinson, Kathy L., "Using Commercial Tankers and Container-ships for Navy Underway Replenishment," 25 pp., Nov 1979, AD A077 836

- PP 264  
Weinland, Robert G., "The U.S. Navy in the Pacific: Past, Present, and Glimpses of the Future," 31 pp., Nov 1979 (Delivered at the International Symposium on the Sea, sponsored by the International Institute for Strategic Studies, The Brookings Institution and the Yomiuri Shimbun, Tokyo, 16-20 Oct 1978) AD A066 837
- PP 265  
Weinland, Robert G., "War and Peace in the North: Some Political Implications of the Changing Military Situation in Northern Europe," 18 pp., Nov 1979 (Prepared for presentation to the Conference of the Nordic Balance in Perspective: The Changing Military and Political Situation," Center for Strategic and International Studies, Georgetown University, Jun 15-16, 1978) AD A077 838
- PP 266  
Utgoff, Kathy Classen, and Brechling, Frank, "Taxes and Inflation," 25 pp., Nov 1979, AD A081 194
- PP 267  
Trost, Robert P., and Vogel, Robert C., "The Response of State Government Receipts to Economic Fluctuations and the Allocation of Counter-Cyclical Revenue Sharing Grants," 12 pp., Dec 1979 (Reprinted from the Review of Economics and Statistics, Vol. LXI, No. 3, August 1979)
- PP 268  
Thomason, James S., "Seaport Dependence and Inter-State Cooperation: The Case of Sub-Saharan Africa," 141 pp., Jan 1980, AD A081 193
- PP 269  
Weiss, Kenneth G., "The Soviet Involvement in the Ogaden War," 42 pp., Jan 1980 (Presented at the Southern Conference on Slavic Studies in October, 1979), AD A082 219
- PP 270  
Rennek, Richard, "Soviet Policy in the Horn of Africa: The Decision to Intervene," 52 pp., Jan 1980 (To be published in "The Soviet Union in the Third World: Success or Failure," ed. by Robert H. Donaldson, Westview Press, Boulder, Co., Summer 1980), AD A081 195
- PP 271  
McConnell, James, "Soviet and American Strategic Doctrines: One More Time," 43 pp., Jan 1980, AD A081 192
- PP 272  
Weiss, Kenneth G., "The Azores in Diplomacy and Strategy, 1940-1945," 46 pp., Mar 1980, AD A085 094
- PP 273  
Nakade, Michael K., "Labor Supply of Wives with Husbands Employed Either Full Time or Part Time," 39 pp., Mar 1980, AD A082 220
- PP 275  
Goldberg, Lawrence, "Recruiters Advertising and Navy Enlistments," 34 pp., Mar 1980, AD A082 221
- PP 276  
Goldberg, Lawrence, "Delaying an Overhaul and Ship's Equipment," 40 pp., May 1980, AD A085 095
- PP 277  
Mangel, Marc, "Small Fluctuations in Systems with Multiple Limit Cycles," 19 pp., Mar 1980 (Published in SIAM J. Appl. Math., Vol. 38, No. 1, Feb 1980) AD A086 229
- PP 278  
Mizrahi, Maurice, "A Targeting Problem: Exact vs. Expected-Value Approaches," 23 pp., Apr 1980, AD A085 096
- PP 279  
Walt, Stephen M., "Causal Inferences and the Use of Force: A Critique of Force Without War," 50 pp., May 1980, AD A085 097
- PP 280  
Goldberg, Lawrence, "Estimation of the Effects of A Ship's Steaming on the Failure Rate of Its Equipment: An Application of Econometric Analysis," 25 pp., Apr 1980, AD A085 098
- PP 281  
Mizrahi, Maurice M., "Comment on 'Discretization Problems of Functional Integrals in Phase Space'," 2 pp., May 1980, AD A094 994
- PP 283  
Dismukes, Bradford, "Expected Demand for the U.S. Navy to Serve as An Instrument of U.S. Foreign Policy: Thinking About Political and Military Environmental Factors," 30 pp., Apr 1980, AD A085 099
- PP 284  
J. Kellison,\* W. Nunn, and U. Sumita,\*\* "The Laguerre Transform," 119 pp., May 1980, AD A085 100  
\*The Graduate School of Management, University of Rochester and the Center for Naval Analyses  
\*\*The Graduate School of Management, University of Rochester
- PP 285  
Rennek, Richard B., "Superpower Security Interests in the Indian Ocean Area," 26 pp., Jun 1980, AD A087 113
- PP 286  
Mizrahi, Maurice M., "On the MKB Approximation to the Propagator for Arbitrary Hamiltonians," 25 pp., Aug 1980 (Published in Journal of Math. Phys., 22(1) Jan 1981), AD A091 307
- PP 287  
Cope, Davis, "Limit Cycle Solutions of Reaction-Diffusion Equations," 33 pp., Jun 1980, AD A087 114
- PP 288  
Golman, Walter, "Don't Let Your Slides Flip You: A Painless Guide to Visuals That Really Aid," 28 pp., Oct 1980, AD A092 732
- PP 289  
Robinson, Jack, "Adequate Classification Guidance - A Solution and a Problem," 7 pp., Aug 1980, AD A091 212
- PP 290  
Watson, Gregory H., "Evaluation of Computer Software in an Operational Environment," 17 pp., Aug 1980, AD A091 213
- PP 291  
Maddala, G. S.\* and Trost, R. P., "Some Extensions of the Nerlove Press Model," 17 pp., Oct 1980, AD A091 946  
\*University of Florida
- PP 292  
Thomas, James A., Jr., "The Transport Properties of Binary Gas Mixtures in Applied Magnetic Fields," 10 pp., Sept 1980 (Published in Journal of Chemical Physics 72(10), 15 May 1980)

- PP 293  
Thomas, James A., Jr., "Evaluation of Kinetic Theory Collision Integrals Using the Generalized Phase Shift Approach," 12 pp., Sept 1980 (Printed in Journal of Chemical Physics 72(10), 15 May 1980)
- PP 294  
Roberts, Stephen S., "French Naval Policy Outside of Europe," 30 pp., Sept 1980 (Presented at the Conference of the Section on Military Studies, International Studies Association Kilauea Island, S.C.), AD A091 306
- PP 295  
Roberts, Stephen S., "An Indicator of Informal Empire: Patterns of U.S. Navy Cruising on Overseas Stations, 1869-1897," 40 pp., Sept 1980 (Presented at Fourth Naval History Symposium, US Naval Academy, 26 October 1979, AD A091 316)
- PP 296  
Dismukes, Bradford and Petersen, Charles C., "Maritime Factors Affecting Iberian Security," (Factores Maritimos Que Afectan La Seguridad Ibeica) 14 pp., Oct 1980, AD A092 733
- PP 297 - Classified
- PP 298  
Mizrahi, Maurice M., "A Markov Approach to Large Missile Attacks," 31 pp., Jan 1981, AD A096,159
- PP 299  
Jondrow, James M. and Levy, Robert A., "Wage Leadership in Construction, 19 pp., Jan 1981, AD A094 797
- PP 300  
Jondrow, James and Schmidt, Peter,\* "On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model," 11 pp., Jan 1981, AD A096 159  
\*Michigan State University
- PP 301  
Jondrow, James M.; Levy, Robert A. and Hughes, Claire, "Technical Change and Employment in Steel, Autos, Aluminum, and Iron Ore, 17 pp., Mar 1981, AD A099 394
- PP 302  
Jondrow, James M. and Levy, Robert A., "The Effect of Imports on Employment Under Rational Expectations," 19 pp., Apr 1981, AD A099 392
- PP 303  
Thomason, James, "The Rarest Commodity in the Coming Resource Wars," 3 pp., Aug 1981 (Published in the Washington Star, April 13, 1981)
- PP 304  
Duffy, Michael K.; Greenwood, Michael J.\* and McDowell, John M.,\*\* "A Cross-Sectional Model of Annual Interregional Migration and Employment Growth: Intertemporal Evidence of Structural Change, 1958-1975," 31 pp., Apr 1981, AD A099 393  
\*University of Colorado  
\*\*Arizona State University
- PP 305  
Munn, Laura K., "An Introduction to the Literature of Search Theory," 32 pp., Jun 1981
- PP 306  
Anger, Thomas E., "What Good Are Warfare Models?" 7 pp., May 1981
- PP 307  
Thomason, James, "Dependence, Risk, and Vulnerability," 43 pp., Jun 1981
- PP 308  
Mizrahi, M.M., "Correspondence Rules and Path Integrals," Jul 1981
- PP 309  
Weinland, Robert G., "An (The?) Explanation of the Soviet Invasion of Afghanistan," 44 pp., May 1981
- PP 310  
Stanford, Janette M. and Tai Te Wu,\* "A Predictive Method for Determining Possible Three-dimensional Foldings of Immunoglobulin Backbones Around Antibody Combining Sites," 19 pp., Jun 1981 (Published in J. theor. Biol. (1981) 88, 421-439  
\*Northwestern University, Evanston, IL
- PP 311  
Bowes, Marianne, Brachling, Frank P. R., and Utgoff, Kathleen P. Classen, "An Evaluation of UI Funds," 13 pp., May 1981 (Published in National Commission on Unemployment Compensation's Unemployment Compensation: Studies and Research, Volume 2, July 1980)
- PP 312  
Jondrow, James; Bowes, Marianne and Levy, Robert, "The Optimum Speed Limit," 23 pp., May 1981
- PP 313  
Roberts, Stephen S., "The U.S. Navy in the 1980s," 36 pp., Jul 1981
- PP 315  
Buck, Ralph V., Capt., "Le Catastrophe by any other name...", Jul 1981

**END  
DATE**